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Gravity Flow Rack's Material Handling System for Just-In-Time (JIT) Production

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Abstract

Effective and efficient material handling (MH) system is crucial in any Just in Time (JIT) production system. A Gravity Flow Rack (GFR) system is one of the very well adopted MH system and very practical in order to optimize the effectiveness of the JIT production system. This paper presents a review on the actual implementation of a GFR system at an automotive component's assembly line in an accord to improve its existing MH system. The main purpose of this implementation is to reduce the material transfer activities while reducing the occupied space; hence reducing the overall production cycle time (CT). The implementation outcomes show significance improvement on the productivity and not to mention the material handling's time. It is proven that the GFR system is still relevant and can be regarded as one of the most effective tool in JIT production.

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1. Introduction

Nowadays, major, medium as well as small local automotive manufacturing companies are experiencing rapid development in terms of technology and system applied, resulted by stronger domestic and global market demands. As the companies grows, the need for efficient MH system also arises especially in the manufacturing area.

Material handling (MH) system is one of the basic components that complement the whole manufacturing operation. This system basically refers to any activities, equipment and procedures related to the moving, storing, protecting and controlling of materials flow in a manufacturing system [1]. It provides the manufacturing system with smooth material flow without excess in-line and out-line inventory. The MH system is categorized as non-value added (NVA) activities which implying that the less MH involved is the better [1]. However it is impossible to totally eliminate the MH activities in any manufacturing operation. Hence an effective and efficient MH system is always the ultimate objective by many companies. Research by Allen, J., Robinson, C. and Steward, D. [1] confirms that efficient MH system helped to reduce 15% to 30% plant's operating cost. Kasul, R. and Motwani, G. [2] supported this statement by highlighting that systematic MH system could increase the material flow's efficiency and it's effectiveness. Others than that, there are several research affirm that systematic MH system promises several advantages to the manufacturing system such as efficient part picking during the assembly process [3], improving operators' ergonomic factors [4], reduction in operators' walking distances, NVA activities and CT [4], reduction in product cost [5], and reduction in WIP stock as well as product's lead time [6].

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MH system is synonymous with JIT production area which requires supply of right and proper materials for the system in the right quantity, place, time, position, sequence and cost. This is to ensure that the products are produced at the right time consuming and fulfilling quality requirements [5]. However, the process of handling and supplying materials can be simple or fairly complex with the increasing of quantity, size and weight of the materials to be supplied. The effectiveness of this system strongly depends on many aspects such as types of conveyance used, temporary storage methods, routes of the material delivery, frequency of the delivery and quantity per delivery. Therefore, the system must be properly designed and tested before applied into the manufacturing line.

This research utilized the case-based approach to demonstrate and document the implementation of a project aimed at improving the MH system of a real JIT automotive assembly line with application of GFR system. It was conducted at a plastic manufacturing plant owned by XYZ Manufacturing Sendirian Berhad. The study explores the design and concepts of the GFR system that emphasized on the productivity per man hour and occupied space in the assembly area. Detail explanations on the overall activities of the GFR implementation including GFR design stages and layout improvement were included. Hence, this paper revealed the actual implementation of a GFR system at an automotive company assembly line. Actual data on the existing assembly area were collated. Summary of the research findings and some suggestions for maintaining the stability of the GFR system presented in the end of this paper.

2. Methods

2.1. Review and Data Collection

Review is conducted to investigate the existing method of materials feeding assembly processes. It was carried out by direct observation on the actual manufacturing activity and reviewing the existing production documents such as Standard Operating Procedure (SOP) and production report. After that, previous manufacturing data were collected from computer data base system called Production Control System (PCS). Average figures, for the past 5 months were calculated to establish baseline for the analysis. For comparison purpose, the data were compared to standard target as registered by the company in their Bill of Material (BOM). Next, line observation was conducted to understand the present conditions of the assembly line as well as to identify types of wastes in the process. Time study was also conducted according to J. Haizer and B. Render [7] and S. A. Lawrence [8]. Time Measurement Sheet (TMS) was used to record all elements process and cycle times (CT) for each process. In the TMS, process time was separated between hand time, transportation time and machine time to clearly picture the process. Along the process, it also includes a number of periodical tasks. Periodical task is a set of tasks that is infrequent but periodically performed by operators along the production process. This task must be separated from the work cycle as it is classified as NVA activity where for this; Periodical Task Check Sheet (PTCS) was used to run the analysis. Last but not least, study on the existing layout; movements of operators inside the line and size of the assembly line were also conducted by using Standard Work Chart (SWC).

2.2. Design the GFR system

To design the GFR system according to scale, Computer aided system called Auto-Cad was utilized. The GFR system was designed by considering the following guidelines [9][10][11]:

- i. Present the parts and components as close as possible to the point of use of operators so they can use both hands simultaneously. This is to reduce walking distance of the operators.
- ii. Applying First in First out (FIFO) system.
- iii. To design the rack by ensuring it can only be occupied by not more than 2 cycles of delivery quantities at one time, by referring to standard line CT. This is to minimize inventory in the assembly line.
- iv. Kitting area to be located near to the assembly line. This is to reduce walking distance of the material handlers.
- v. Parts and components are replenished from outside of the assembly area by material handler. By this, the material handler will not freely enter the line which could disturb the operators.
- vi. Empty poly-boxes are returned from inside of the assembly area by operators by using gravity feeding system, where for this the rack is inclined to outward.
- vii. Size of poly-boxes on the flow rack must be convenient to handle individually by the operators and material handlers without assistance and also must be standardized.
- viii. The GFR is designed with appropriate degree of inclination so that process of storage is more ergonomic.
- ix. Proper address system at feeding in and feeding out the flow rack to avoid wrong parts supplied to operators.
- x. For small components, the GFR should designed according to the size of the boxes.

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